

New path found for a better & comprehensive therapy for Alzheimer's disease

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A new path involving nanoparticles integrating a polyphenol with antioxidant properties found in green tea, neurotransmitter, and amino acid has the potential to treat Alzheimer's Disease (AD) by changing the path of the progression of the disease, slowing it, improving memory, and supporting thinking skills.

Alzheimer's disease is a growing global health concern. As the population ages, the disease poses significant challenges in terms of patient care, economic burden underlining the need for effective treatments and preventive strategies.

Conventional Alzheimer's therapies often target only a single pathological feature such as amyloid aggregation or oxidative stress, yielding limited clinical benefit. However, AD which is a multifactorial disease and hence needed a multifunctional nanopatform capable of addressing multiple disease mechanisms simultaneously.

Researchers at Institute of Nano Science and Technology (INST), Mohali, an autonomous institute of the Department of Science and Technology (DST), integrated nanotechnology, molecular biology, and computational modelling to develop a multifunctional therapy for Alzheimer's Disease.

The therapy integrates epigallocatechin-3-gallate (EGCG) an antioxidant found in green tea, dopamine, a neurotransmitter important for mood and tryptophan, an amino acid involved in many cellular functions into a nanoparticle called EGCG-dopamine-tryptophan nanoparticles (EDTNPs). This enables it to simultaneously targets amyloid aggregation, oxidative stress, inflammation, and neuronal degeneration, four key pathological hallmarks of AD.

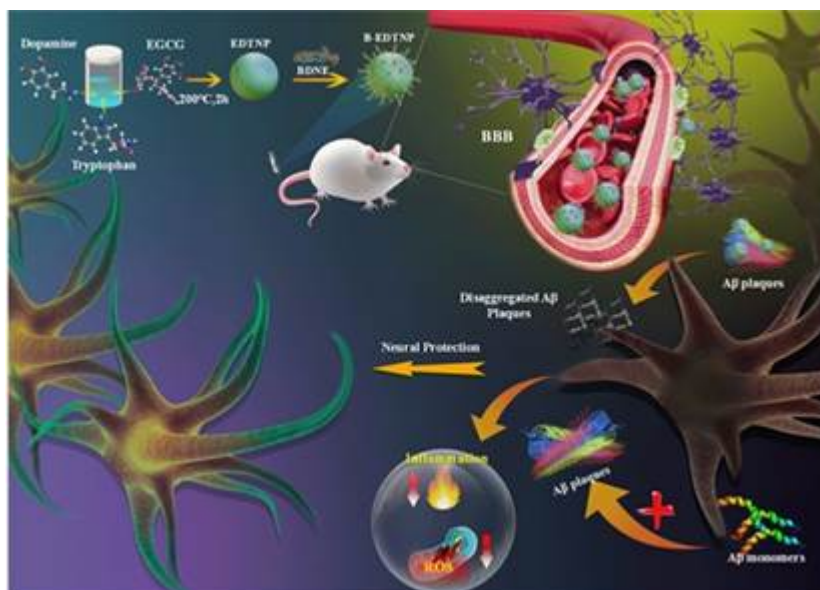


Fig 1 Illustrating the synthesis of NPs and their multifunctional role in combating AD.

Incorporation of Brain-Derived Neurotrophic Factor (BDNF), a protein crucial for the survival, growth, and function of neurons onto EDTNPs (B-EDTNPs) creates a dual-action nanopatform that not only clears neurotoxic Amyloid Beta aggregates (protein clumps that disrupt neural function and drive Alzheimer's disease pathology) but also enhances neuronal regeneration. This is a rare approach in Alzheimer's therapeutics which uniquely combines antioxidant, anti-amyloid, and neurotrophic actions for the therapy.

The research work carried out by Dr. Jiban Jyoti Panda and team (Himanshu Shekhar Panda & Sumit) from INST, Mohali, with support from Dr. Ashok Kumar Datusalia (NIPER Raebareli) and Dr Nisha Singh (Gujrat Biotechnology University), involves the synthesis of EDTNPs using biocompatible assembly techniques like pressure assisted hydrothermal and electrostatic based co-incubation methods to combine antioxidant, neurotransmitter, and amino acid components. These nanoparticles were then functionalized with BDNF, producing B-EDTNPs with enhanced neuroprotective potential.

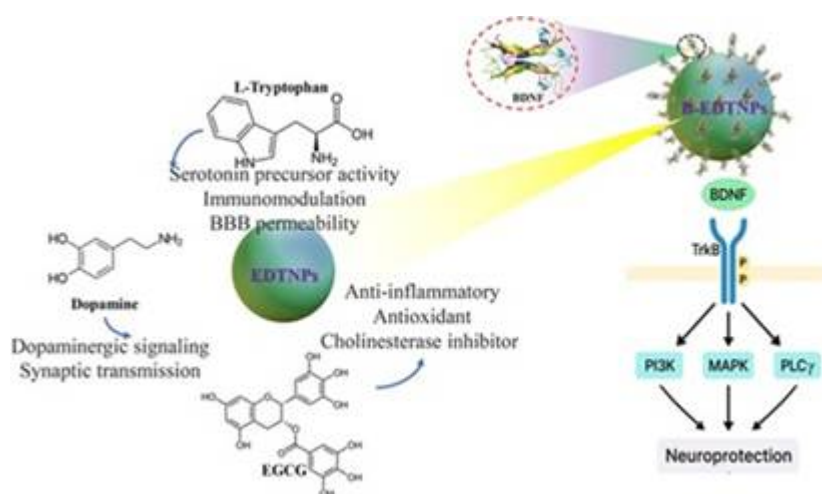


Fig.2. Illustrating the feasible mechanism of action of NPs [TrkB (Tropomyosin receptor kinase B); PI3K (Phosphoinositide 3-kinase); MAPK (Mitogen-activated protein kinase); PLC γ (Phospholipase C-gamma); PP (pyrophosphate)].

In lab experiments and mouse models, these nanoparticles disassembled toxic plaques, reduced inflammation, restored balance inside brain cells, and even improved memory and learning. Computer simulations further confirmed that the nanoparticles latch onto harmful A β fibrils and pull them apart at the molecular level.

This research, published in the Journal, "Small", could help people with Alzheimer's disease by offering a treatment that works on multiple levels. The nanoparticles not only remove harmful protein plaques but also reduce brain stress, inflammation and help nerve cells grow through BDNF. In the long run, the therapy could make life better for patients, ease the burden on caregivers, and lead to more effective and personalized treatments for Alzheimer's disease.

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